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Editors: Jacco van Loon, Ambra Nanni and Albert Zijlstra

Editorial

Dear Colleagues,

It is our pleasure to present you the 213th issue of the AGB Newsletter, including several rather original or controversial contributions.

Sakib Rasool suggested the Food for Thought below. As always, please send your responses to astro.agbnews@keele.ac.uk for discussion in next month's editorial.

Looking for a postdoctoral or Ph.D. position? Check out the adverts in Belgium and Spain. Or fancy a professorship? Check out Monash!

Also have a look at the announcements of two summer schools and a workshop.

The next issue is planned to be distributed around the 1st of May.

Editorially Yours,
Jacco van Loon, Ambra Nanni and Albert Zijlstra

Food for Thought

This month's thought-provoking statement is:

Do all Planetary Nebulae have a halo?

Reactions to this statement or suggestions for next month's statement can be e-mailed to astro.agbnews@keele.ac.uk (please state whether you wish to remain anonymous)

Refereed Journal Papers

High angular resolution stellar imaging with occultations from the Cassini spacecraft II: Kronocyclic tomography

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We present an advance in the use of Cassini observations of stellar occultations by the rings of Saturn for stellar studies. Stewart et al. (2013) demonstrated the potential use of such observations for measuring stellar angular diameters. Here, we use these same observations, and tomographic imaging reconstruction techniques, to produce two dimensional images of complex stellar systems. We detail the determination of the basic observational reference frame. A technique for recovering model-independent brightness profiles for data from each occulting edge is discussed, along with the tomographic combination of these profiles to build an image of the source star. Finally we demonstrate the technique with recovered images of the α Centauri binary system and the circumstellar environment of the evolved late-type giant star, Mira.

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Modeling the H I 21-cm line profile from circumstellar shells around red giants

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We present H I line profiles for various models of circumstellar shells around red giants. In the calculations we take into account the effect of the background at 21 cm, and show that in some circumstances it may have an important effect on the shape and intensity of the observed line profiles. We show that self-absorption should also be considered depending on the mass loss rate and the temperature reached by circumstellar gas. H I emission from circumstellar shells has been mostly reported from stars with mass loss rates around 10^{-7} solar masses per year. We discuss the possible reasons for the non detection of many sources with larger mass loss rates that are hallmarks of the end of the AGB phase. Although radiative transfer effects may weaken the line emission, they cannot alone account for this effect. Therefore, it seems likely that molecular hydrogen, rather than atomic hydrogen, dominates the composition of matter expelled by stars at the end of their evolution on the Asymptotic Giant Branch. However sensitive H I observations can still yield important information on the kinematics and physical properties of the circumstellar material at large distances from central stars with heavy mass loss, despite the low abundance of atomic hydrogen.

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Millimeter polarisation of the protoplanetary nebula OH 231.8+4.2: A follow-up study with CARMA

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In order to investigate the characteristics and influence of the magnetic field in evolved stars, we performed a follow-up investigation of our previous submillimeter analysis of the proto-planetary nebula (PPN) OH 231.8+4.2 (Sabin et al. 2014), this time at 1.3mm with the CARMA facility in polarisation mode for the purpose of a multi-scale analysis. OH 231.8+4.2 was observed at $\sim 2\farcs5$ resolution and we detected polarised emission above the 3-σ threshold (with a mean polarisation fraction of 3.5%). The polarisation map indicates an overall organised magnetic field within the nebula. The main finding in this paper is the presence of a structure mostly compatible with an ordered toroidal component that is aligned with the PPN's dark lane. We also present some alternative magnetic field configuration to explain the structure observed. These data complete our previous SMA submillimeter data for a better investigation and understanding of the magnetic field structure in OH 231.8+4.2.

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Isotopic anomalies in the Fe-group elements in meteorites and connections to nucleosynthesis in AGB stars

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We study the effects of neutron captures in AGB stars on "Fe-group" elements, with an emphasis on Cr, Fe, and Ni. These elements show anomalies in ^{54}Cr, ^{58}Fe, and ^{64}Ni in solar-system materials, which are commonly attributed to SNe. However, as large fractions of the interstellar medium (ISM) were reprocessed in AGB stars, these elements were reprocessed, too. We calculate the effects of such reprocessing on Cr, Fe, and Ni through 1.5 $M_\odot$ and 3 $M_\odot$ AGB models, adopting solar and 1/3 solar metallicities. All cases produce excesses of ^{54}Cr, ^{58}Fe, and ^{64}Ni, while the other isotopes are little altered; hence, the observations may be explained by AGB processing. The results are robust and not dependent on the detailed initial isotopic composition. Consequences for other "Fe group" elements are then explored. They include ^{50}Ti excesses, and some production of ^{46,47,49}Ti. In many circumstellar condensates, Ti quantitatively reflects these effects of AGB neutron captures. Scatter in the data results from small variations (granularity) in the isotopic composition of the local ISM. For Si, the main effects are instead due to variations in the local ISM from different SNe sources. The problem of Ca is discussed, particularly with regard to ^{48}Ca. The measured data are usually represented assuming terrestrial values for ^{42}Ca/^{44}Ca. Materials processed in AGB stars or sources with variable initial ^{42}Ca/^{44}Ca ratios can give apparent ^{48}Ca excesses/deficiencies, attributed to SNe. The broader issue of Galactic Chemical Evolution is also discussed in view of the isotopic granularity in the ISM.

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Spatially resolved kinematic observations of the planetary nebulæ Hen 3-1333 and Hen 2-113

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We have performed integral field spectroscopy of the planetary nebulæ Hen 3-1333 (PN G332.9−09.9) and Hen 2-113 (PN G321.0+03.9), which are unusual in exhibiting dual-dust chemistry and multipolar lobes but also ionized by late-type [WC 10] central stars. The spatially resolved velocity distributions of the Hα emission line were used to determine their primary orientations. The integrated Hα emission profiles indicate that Hen 3-1333 and Hen 2-113 expand with velocities of ~ 32 and 23 km s^{-1}, respectively. The *Hubble* Space Telescope observations suggest that these planetary nebulæ have two pairs of tenuous lobes extending upwardly from their bright compact cores. From three-dimensional geometric models, the primary lobes of Hen 3-1333 and Hen 2-113 were found to have inclination angles of about -30° and 40° relative to the line of sight, and position angles of -15° and 65° measured east of north in the equatorial coordinate system, respectively.

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Binary population synthesis for the core-degenerate scenario of type Ia supernova progenitors

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The core-degenerate (CD) scenario has been suggested to be a possible progenitor model of type Ia supernovæ (SNe Ia), in which a carbon–oxygen white dwarf (CO WD) merges with the hot CO core of a massive asymptotic giant branch (AGB) star during their common-envelope phase. However, the SN Ia birthrates for this scenario are still uncertain. We conducted a detailed investigation into the CD scenario and then gave the birthrates for this scenario using a detailed Monte Carlo binary population synthesis approach. We found that the delay times of SNe Ia from this scenario are ~ 70 Myrs – 1400 Myrs, which means that the CD scenario contributes to young SN Ia populations. The Galactic SN Ia birthrates for this scenario are in the range of $\sim 7.4\times10^{-5}$ yr^{-1} – 3.7×10^{-4} yr^{-1}, which roughly accounts for $\sim$ 2–10% of all SNe Ia. This indicates that, under the assumptions made here, the CD scenario only contributes a small portion of all SNe Ia, which is not consistent with the results of Ilkov & Soker (2013).

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Molecular ions in the O-rich evolved star OH 231.8+4.2: HCO^+, $H^{13}CO^+$ and first detection of SO^+, N_2H^+, and H_3O^+

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OH 231.8+4.2, a bipolar outflow around a Mira-type variable star, displays a unique molecular richness amongst circumstellar envelopes (CSEs) around O-rich AGB and post-AGB stars. We report line observations of the HCO^+ and $H^{13}CO^+$ molecular ions and the first detection of SO^+, N_2H^+, and (tentatively) H_3O^+ in this source. SO^+ and H_3O^+ have not been detected before in CSEs around evolved stars. These data have been obtained as part of a full mm-wave and far-IR spectral line survey carried out with the IRAM 30-m radio telescope and with *Herschel*/HIFI. Except for H_3O^+, all the molecular ions detected in this work display emission lines with broad profiles (FWHM $\sim$ 50–90 km s^{-1}), which indicates that these ions are abundant in the fast bipolar outflow of OH 231.8. The narrow profile (FWHM $\sim$ 14 km s^{-1}) and high critical densities ($> 10^6$ cm^{-3}) of the H_3O^+ transitions observed are consistent with this ion arising from denser, inner (and presumably warmer) layers of the fossil remnant of the slow AGB CSE at the core of the nebula. From rotational diagram analysis, we deduce excitation temperatures of $T_{ex} \sim$ 10–20 K for all ions except for H_3O^+, which is most consistent with $T_{ex} \sim 100$ K. Although uncertain, the higher excitation temperature suspected for H_3O^+ is similar to that recently found for H_2O and a few other molecules, which selectively trace a previously unidentified, warm nebular component. The column densities of the molecular ions reported here are in the range $N_{tot} \sim [1\text{–}8] \times 10^{13}$ cm^{-2}, leading to beam-averaged fractional abundances relative to H_2 of $X(HCO^+) \approx 10^{-8}$, $X(H^{13}CO^+) \approx 2 \times 10^{-9}$, $X(SO^+) \approx 4 \times 10^{-9}$, $X(N_2H^+) \approx 2 \times 10^{-9}$, and $X(H_3O^+) \approx 7 \times 10^{-9}$ cm^{-2}. We have performed chemical kinetics models to investigate the formation of these ions in OH 231.8 as the result of standard gas phase reactions initiated by cosmic-ray and UV-photon ionization. The model predicts that HCO^+, SO^+, and H_3O^+ can form with abundances comparable to the observed average values in the external layers of the slow central core (at $\sim [3\text{–}8] \times 10^{16}$ cm); H_3O^+ would also form quite abundantly in regions closer to the center ($X(H_3O^+) \sim 10^{-9}$ at $\sim 10^{16}$ cm). For N_2H^+, the model abundance is lower than the observed value by more than two orders of magnitude. The model fails to reproduce the abundance enrichment of HCO^+, SO^+, and N_2H^+ in the lobes, which is directly inferred from the broad emission profiles of these ions. Also, in disagreement with the narrow H_3O^+ spectra, the model predicts that this ion should form in relatively large, detectable amounts ($\approx 10^{-9}$) in the external layers of the slow central core and in the high-velocity lobes. Some of the model-data discrepancies are reduced, but not suppressed, by lowering the water content and enhancing the elemental nitrogen abundance in the envelope. The remarkable chemistry of OH 231.8 probably reflects the molecular regeneration process within its envelope after the passage of fast shocks that accelerated and dissociated molecules in the AGB wind $\sim$ 800 yr ago.

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Photoluminescence of silicon-vacancy defects in nanodiamonds of different chondrites

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Photoluminescence spectra show that silicon impurity is present in lattice of some nanodiamond grains (ND) of various chondrites as a silicon-vacancy (SiV) defect. The relative intensity of the SiV band in the diamond-rich separates depends on chemical composition of meteorites and on size of ND grains. The strongest signal is found for the size separates enriched in small grains; thus confirming our earlier conclusion that the SiV defects preferentially reside in the smallest (≤ 2 nm) grains. The difference in relative intensities of the SiV luminescence in the diamond-rich separates of individual meteorites are due to variable conditions of thermal metamorphism of their parent bodies and/or uneven sampling of nanodiamonds populations. Annealing of separates in air eliminates surface sp^2-carbon, consequently, the SiV luminescence is enhanced. Strong and well-defined luminescence and absorption of the SiV defect is a promising feature to locate cold (< 250 °C) nanodiamonds in space.

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Dissecting the AGB star L_2 Puppis: a torus in the making

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The circumstellar environment of L_2 Pup, an oxygen-rich semiregular variable, was observed to understand the evolution of mass loss and the shaping of ejecta in the late stages of stellar evolution. High-angular resolution observations from a single 8 m telescope were obtained using aperture masking in the near-infrared (1.64, 2.30 and 3.74 μm) on the NACO/VLT, both in imaging and polarimetric modes. The aperture-masking images of L_2 Pup at 2.30 μm show a resolved structure that resembles a toroidal structure with a major axis of $\sim$ 140 milliarcseconds (mas) and an east–west orientation. Two clumps can be seen on either side of the star, $\sim$ 65 mas from the star, beyond the edge of the circumstellar envelope (estimated diameter is $\sim$ 27 mas), while a faint, hook-like structure appear toward the northeast. The patterns are visible both in the imaging and polarimetric mode, although the latter was only used to measure the total intensity (Stokes I). The overall shape of the structure is similar at the 3.74-μm pseudo-continuum (dust emission), where the clumps appear to be embedded within a dark, dusty lane. The faint, hook-like patterns are also seen at this wavelength, extending northeast and southwest with the central, dark lane being an apparent axis of symmetry. We interpret the structure as a circumstellar torus with inner radius of 4.2 au. With a rotation velocity of 10 km s^{-1} as suggested by the SiO maser profile, we estimate a stellar mass of 0.7 $M_\odot$.

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Quantum dynamics of CO–H_2 in full dimensionality

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Accurate rate coefficients for molecular vibrational transitions due to collisions with H_2, critical for interpreting infrared astronomical observations, are lacking for most molecules. Quantum calculations are the primary source of such data, but reliable values that consider all internal degrees of freedom of the collision complex have only been reported for H_2–H_2 due to the difficulty of the computations. Here we present essentially exact, full-dimensional dynamics computations for rovibrational quenching of CO due to H_2 impact. Using a high-level six-dimensional potential surface, time-independent scattering calculations, within a full angular momentum coupling formulation, were performed for the de-excitation of vibrationally excited CO. Agreement with experimentally determined results confirms the accuracy of the potential and scattering computations, representing the largest of such calculations performed to date. This investigation advances computational quantum dynamical studies representing initial steps towards obtaining CO–H_2 rovibrational quenching data needed for astrophysical modelling.

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Nuclear ashes and outflow in the eruptive star Nova Vul 1670

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CK Vulpeculæ was observed in outburst in 1670–1672, but no counterpart was seen until 1982, when a bipolar nebula was found at its location. Historically, CK Vul has been considered to be a nova (Nova Vul 1670), but a similarity to 'red transients', which are more luminous than classical nova and thought to be the result of stellar collisions, has re-opened the question of CK Vul's status. Red transients cool to resemble late M-type stars, surrounded by circumstellar material rich in molecules and dust. No stellar source has been seen in CK Vul, though a radio continuum source was identified at the expansion centre of the nebula. Here we report CK Vul is surrounded by chemically rich molecular gas with peculiar isotopic ratios, as well as dust. The chemical composition cannot be reconciled with a nova or indeed any other known explosion. In addition, the mass of the surrounding gas is too high for a nova, though the conversion from observations of CO to a total mass is uncertain. We conclude that CK Vul is best explained as the remnant of a merger of two stars.

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A general abundance problem for all self-enrichment scenarios for the origin of multiple populations in globular clusters

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A number of stellar sources have been advocated as the origin of the enriched material required to explain the abundance anomalies seen in ancient globular clusters (GCs). Most studies to date have compared the yields from potential sources (asymptotic giant branch stars (AGBs), fast rotating massive stars (FRMS), high mass interacting binaries (IBs), and very massive stars (VMS)) with observations of specific elements that are observed to vary from star-to-star in GCs, focussing on extreme GCs such as NGC 2808, which display large He variations. However, a consistency check between the results of fitting extreme cases with the requirements of more typical clusters, has rarely been done. Such a check is particularly timely given the constraints on He abundances in GCs now available. Here we show that all of the popular enrichment sources fail to reproduce the observed trends in GCs, focussing primarily on Na, O and He. In particular, we show that any model that can fit clusters like NGC 2808, will necessarily fail (by construction) to fit more typical clusters like 47 Tuc or NGC 288. All sources severely over-produce He for most clusters. Additionally, given the large differences in He spreads between clusters, but similar spreads observed in Na–O, only sources with large degrees of stochasticity in the resulting yields will be able to fit the observations. We conclude that no enrichment source put forward so far (AGBs, FRMS, IBs, VMS – or combinations thereof) is consistent with the observations of GCs. Finally, the observed trends of increasing [N/Fe] and He spread with increasing cluster mass cannot be resolved within a self-enrichment framework, without further exacerbating the mass budget problem.

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The evolved circumbinary disk of AC Her: a radiative transfer, interferometric and mineralogical study

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Many post-asymptotic giant branch (post-AGB) stars in binary systems have an infrared (IR) excess arising from a dusty circumbinary disk. The disk formation, current structure, and further evolution are, however, poorly understood. We aim to constrain the structure of the circumstellar material around the post-AGB binary and RV Tauri pulsator AC Her. We want to constrain the spatial distribution of the amorphous as well as of the crystalline dust.
We present very high-quality mid-IR interferometric data that were obtained with the MIDI/VLTI instrument. We analyse the MIDI visibilities and differential phases in combination with the full SED, using the MCMax radiative transfer code, to find a good structure model of AC Her's circumbinary disk. We include a grain size distribution and midplane settling of dust self-consistently in our models. The spatial distribution of crystalline forsterite in the disk is investigated with the mid-IR features, the 69-μm band and the 11.3-μm signatures in the interferometric data.
All the data are well fitted by our best model. The inclination and position angle of the disk are well determined at $i = 50 \pm 8°$ and $PA = 305 \pm 10°$. We firmly establish that the inner disk radius is about an order of magnitude larger than the dust sublimation radius. The best-fit dust grain size distribution shows that significant grain growth has occurred, with a significant amount of mm-sized grains now being settled to the midplane of the disk. A large total dust mass $> 10^{-3}$ M$_\odot$ is needed to fit the sub-mm fluxes. By assuming $\alpha_{\rm turb} = 0.01$ a good fit is obtained with a small grain size power law index of 3.25, combined with a small gas/dust ratio < 10. The resulting gas mass is compatible with recent estimates employing direct gas diagnostics. The spatial distribution of the forsterite is different from the amorphous dust, as more warm forsterite is needed in the surface layers of the inner disk.
The disk in the AC Her system is in a very evolved state, with its small gas/dust ratio and large inner hole. Mid-IR interferometry offers unique constraints, complementary to mid-IR features, for studying the mineralogy in disks. A better *uv* coverage is needed to constrain in detail the distribution of the crystalline forsterite in the disk of A Her, but we find strong similarities with the proto-planetary disk HD 100546.

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Model of the vibrationally excited H_2O maser at 658 GHz in circumstellar envelopes around asymptotic giant branch stars

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The model is presented of H_2O maser in the 1_{10}–1_{01} line within the first excited vibrational state of the molecule around oxygen-rich asymptotic giant branch stars. It is suggested that the maser cloud is located in the inner layers of the circumstellar envelope where intense dust formation takes place. The calculations took into account rotational levels belonging to the five lowest vibrational states of the H_2O molecule. The model predicts the gain values of the 658-GHz maser about 10^{-14}–10^{-13} cm^{-1} at H_2 molecule concentrations 10^9–10^{11} cm^{-3} and at high ortho-H_2O concentrations $\gtrsim 10^5$ cm^{-3}. The gas temperatures 1000–1500 K are considered to be a necessary condition for the effective maser operation. Results are presented for other maser transitions of the excited vibrational states of the molecule.

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Sub-stellar fragmentation in self-gravitating fluids with a major phase transition

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The existence of sub-stellar cold H_2 globules in planetary nebulæ and the mere existence of comets suggest that the physics of cold interstellar gas might be much richer than usually envisioned. We study the case of a cold gaseous medium in ISM conditions which is subject to a gas-liquid/solid phase transition. First the equilibrium of such fluids is studied using the virial theorem and linear stability analysis. Then the non-linear dynamics is studied by using simulations in order to characterize the expected formation of solid bodies analogous to comets. The simulations are run with a state of the art molecular dynamics code (LAMMPS). The long-range gravitational forces can be taken into account together with short-range molecular forces with finite limited computational resources by using super-molecules, provided the right scaling is followed. The concept of super-molecule is tested with simulations, allowing to correctly satisfy the ideal gas Jeans instability criterion for one-phase fluids. The simulations show that fluids presenting a phase transition are gravitationally unstable as well, independent of the strength of the gravitational potential, producing two distinct kinds of sub-stellar bodies, those dominated by gravity ("planetoids") and those dominated by molecular attractive force ("comets"). Observations, formal analysis and computer simulations suggest the possibility of the formation of sub-stellar H_2 clumps in cold molecular clouds due to the combination of phase transition and gravity. Fluids in a phase transition are gravitationally unstable, independent of the strength of the gravitational potential. Small H_2 clumps may form even at relatively high temperatures, up to 400–600K according to virial analysis. The combination of phase transition and gravity may be relevant for a wider range of astrophysical situations, such as proto-planetary disks.

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Beyond mixing-length theory: A step toward 321D

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We present a physical basis for algorithms to replace mixing-length theory (MLT) in stellar evolutionary computations. The 321D procedure is based on three-dimensional (3D) time-dependent solutions of the Navier–Stokes equations, including the Kolmogorov cascade as a sub-grid model of dissipation (implicit large eddy simulations; ILES). We use Reynolds-averaged Navier–Stokes (RANS) averaging to make 3D simulation data concise, and use 3D simulations to give RANS closure. We sketch a simple algorithm, which is non-local and time-dependent, with both MLT and the Lorenz convective roll as particular subsets of solutions. The damping length is determined from a balance between the large-scale driving and damping at the Kolmogorov scale. We find that (1) braking regions (boundary layers in which mixing occurs) automatically appear beyond the edges of convection as defined by the Schwarzschild criterion, (2) dynamic (non-local) terms imply a non-zero turbulent kinetic energy flux (unlike MLT), (3) the effects of composition gradients on flow are important, and (4) convective boundaries in neutrino-cooled stages differ in nature from those in photon-cooled stages. The 321D approach may be easily generalized, and allows connections with modern research on turbulent flow of solar and terrestrial fluids and plasmas. Calibration to astronomical systems is unnecessary, so the approach can be predictive rather than merely descriptive. Implications for solar abundances, helioseismology, asteroseismology, nucleosynthesis yields, supernova progenitors and core collapse are indicated.

Submitted to ApJ
Available from arXiv:1503.00342

^{12}CO emission from the Red Rectangle

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Observations of an unprecedented quality made by ALMA on the Red Rectangle of CO(3–2) and CO(6–5) emissions are analysed jointly with the aim of obtaining as simple as possible a description of the gas morphology and kinematics. Evidence is found for polar conical outflows and for a broad equatorial torus in rotation and expansion. Simple models of both are proposed. Comparing CO(6–5) and CO(3–2) emissions provides evidence for a strong temperature enhancement over the polar outflows. Continuum emission (dust) is seen to be enhanced in the equatorial region. Observed asymmetries are briefly discussed.

Submitted to Research in Astronomy and Astrophysics
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The first pre-supersoft X-ray binary

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We report the discovery of an extremely close white dwarf plus F dwarf main-sequence star in a 12 hour binary identified by combining data from the RAdial Velocity Experiment (RAVE) survey and the Galaxy Evolution Explorer (GALEX) survey. A combination of spectral energy distribution fitting and optical and *Hubble* Space Telescope ultraviolet spectroscopy allowed us to place fairly precise constraints on the physical parameters of the binary. The system, TYC 6760-497-1, consists of a hot $T_{\rm eff} \sim 21,500$ K, $M_{\rm WD} \sim 0.65$ M$_\odot$ white dwarf and an F8 star ($M_{\rm MS} \sim 1.23$ M$_\odot$, $R_{\rm MS} \sim 1.35$ R$_\odot$) seen at a low inclination ($i \sim 35°$). The system is likely the descendent of a binary that contained the F star and a $\sim$ 2-M$_\odot$ A-type star that filled its Roche-lobe on the second asymptotic giant branch, initiating a common envelope phase. The F star is extremely close to Roche-lobe filling and there is likely to be a short phase of thermal timescale mass-transfer onto the white dwarf. During this phase it will grow in mass by up to 20 per cent, until the mass ratio reaches close to unity, at which point it will appear as a standard cataclysmic variable star. Therefore, TYC 6760-497-1 is the first known progenitor of a super-soft source system, but will not undergo a supernova Ia explosion. Once an accurate distance to the system is determined by Gaia, we will be able to place very tight constraints on the stellar and binary parameters.

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Available from arXiv:1503.07151

Far-infrared study of K giants in the solar neighborhood: Connection between Li enrichment and mass-loss

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A small group of red giant branch (RGB) stars are known to have anomalous Li enhancement whose origin is still not well understood. Some studies have proposed that the Li enhancement in RGB stars is correlated to their far-IR excess, a result of mass loss. Studies to confirm such a correlation have a significant bearing on our understanding of the Galactic Li enhancement. We searched for a correlation between the two anomalous properties of K giants: Li enhancement and IR excess from an unbiased survey of a large sample of RGB stars. A sample of 2000 low-mass K giants with accurate astrometry from the *Hipparcos* catalog was chosen for which Li abundances have been determined from low-resolution spectra. Far-infrared data were collected from the WISE and IRAS catalogs. To probe the correlation between the two anomalies, we supplemented 15 Li-rich K giants discovered from this sample with 25 known Li-rich K giants from other studies. Dust shell evolutionary models and spectral energy distributions were constructed using the code DUSTY to estimate different dust shell properties, such as dust evolutionary time scales, dust temperatures, and mass-loss rates. Among 2000 K giants, we found about two dozen K giants with detectable far-IR excess, and surprisingly, none of them are Li-rich. Similarly, the 15 new Li-rich K giants that were identified from the same sample show no evidence of IR excess. Of the total 40 Li-rich K giants, only 7 show IR excess. Important is that K giants with Li enhancement and/or IR excess begin to appear only at the bump on the RGB. Results show that K giants with IR excess are very rare, similar to K giants with Li enhancement. This may be due to the rapid differential evolution of dust shell and Li depletion compared to RGB evolutionary time scales. We also infer from the results that during the bump evolution, giants probably undergo some internal changes, which are perhaps the cause of mass-loss and Li-enhancement events. However, the available observational results do not ascertain that these properties are correlated. That a few Li-rich giants have IR excess seems to be pure coincidence.

Accepted for publication in Astronomy & Astrophysics
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Conference Paper

Phase-lag distances of OH masing AGB stars

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[3]Jodrell Bank Centre for Astrophysics, Department of Physics and Astronomy, University of Manchester, UK

Distances to AGB stars with optically thick circumstellar shells cannot be determined using optical parallaxes. However, for stars with OH 1612 MHz maser emission emanating from their circumstellar shells, distances can be determined by the phase-lag method. This method combines a linear diameter obtained from a phase-lag measurement with an angular diameter obtained from interferometry. The phase-lag of the variable emission from the back and front sides of the shells has been determined for 20 OH/IR stars in the galactic disk. These measurements are based on a monitoring program with the Nançay radio telescope ongoing for more than 6 years. The interferometric observations are continuing. We estimate that the uncertainties of the distance determination will be $\sim 20\%$.

Oral contribution, published in "Why Galaxies Care About AGB Stars III", Vienna 2014, eds. F. Kerschbaum, J. Hron & R. Wing
Available from arXiv:1503.04674
and from www.hs.uni-hamburg.de/nrt-monitoring

3 (co-supervised) Ph.D. positions Université libre de Bruxelles – Katholieke Universiteit Leuven – Royal Observatory of Belgium

Three Ph.D. positions are open in the framework of the STARLAB project (see website below for a short description) involving the Institut d'Astronomie of the Université libre de Bruxelles, the Royal Observatory of Belgium, and the Instituut voor Sterrenkunde of the Katholieke Universiteit Leuven, all located within 25 kms of each other in central Belgium.
The goal of the STARLAB project is to improve our understanding of key physical and chemical processes at work in single and binary low- and intermediate-mass stars. A first Ph.D. project is focused on abundance determinations in late-type stars as tracers for nucleosynthesis and mixing processes, another on binary-star interaction physics, and the third one on the study of the circumstellar environment of late-type mass-losing stars as tracers for the mass loss processes.

See also http://www.astro.ulb.ac.be/pmwiki/BRAIN/PhD

Post-doc position Institut d'Astronomie et d'Astrophysique, Université libre de Bruxelles

Applications are invited for a Postdoctoral Research Position at the Institute of Astronomy and Astrophysics of the Université libre de Bruxelles, Belgium (http://www.astro.ulb.ac.be), in the framework of the project "Extrinsic stars in the Gaia era". Gaia-ESO (GES) is a public spectroscopic survey, targeting more than 10^5 stars, systematically covering all major components of the Milky Way, from Halo to star-forming regions, providing a homogeneous overview of the distributions of kinematics and elemental abundances, thus complementing the Gaia data. It uses the Very Large Telescope FLAMES instrument.

The main scientific interests of the IAA group are detailed abundances in late-type stars, stellar evolution, binary star evolution and nucleosynthesis. The group is strongly involved in the Gaia-ESO Survey and moreover has a privileged access to the HERMES high-resolution spectrograph. The successful applicant will participate in a research project entitled "Extrinsic stars in the Gaia era" and will work in the GES consortium, in particular in WG14 in charge of non-standard objects. He/she will be involved in spectroscopic binary detection as well as detection and analysis of non-standard objects within the GES and possibly HERMES.

See also http://www.astro.ulb.ac.be//pmwiki/pub/Post-doc-GES.pdf

Dust formation in circumstellar envelopes around evolved stars: astronomical observations and models Instituto de Ciencia de Materiales de Madrid, CSIC, Madrid, Spain

Ph.D. position:
Dust formation in circumstellar envelopes around evolved stars: astronomical observations and models Interdisciplinary Project funded by ERC Grant 610256: NANOCOSMOS

We look for a motivated student with a Degree in Chemistry or Physics and a Master in Astrophysics, Physical Chemistry, or Theoretical Chemistry to carry out a Ph.D. Thesis project.

Project:
Dust grains are a ubiquitous component of the interstellar medium, but they are synthesized during the latest evolutionary stages of stars. The most important factories of interstellar dust are low mass stars in the red giant phase, concretely in the asymptotic giant branch (AGB) stage. These stars lose mass as stellar winds and create an extended envelope where dust grains form when the temperature falls below 2000 K. However, the exact formation mechanisms of dust grains (nucleation + growth) and the resulting chemical composition, size, and shape of grains are far from being well understood. The main driver of the current Ph.D. project is also the main driver of the interdisciplanry Project funded by ERC Grant NANOCOSMOS, i.e. to achieve a better understanding of the formation of dust in evolved stars. More specifically, the Ph.D. project will cover three different aspects:

- Theoretical modelling of the process of formation of dust grains: thermodynamic quantification of the most likely condensates in envelopes of carbon- and oxygen-rich AGB stars, and non-equilibrium (chemical kinetics) modelling of the processes of nucleation and grain growth.
- Astronomical observations with radiotelescopes (IRAM, ALMA, etc.) and infrared telescopes (IRTF, SOFIA, etc.) to study the gas phase precursors of dust grains in the inner regions of circumstellar envelopes around AGB stars.
- Interpretation of the results obtained from simulation chamber STARDUST, which is currently being installed at our institution, and implementation on the models of grain formation: This third part will be carried out at the end of the project, depending on the status of the machine.

Institution:
The Instituto de Ciencia de Materiales de Madrid, located in the campus of the Universidad Autónoma de Madrid (easy to access by public transport), belongs to the CSIC (Consejo Superior de Investigaciones Científicas) and is an internationally recognized research institution in the area of material science. The Molecular Astrophysics group, within which the Ph.D. project will be carried out, has recently moved to this institution to promote the synergy between research groups working in the areas of nanoparticles and molecular astrophysics, within the NANOCOSMOS project. The address of the institute is:
Instituto de Ciencia de Materiales de Madrid (CSIC)
Calle Sor Juana Inés de la Cruz 3 Cantoblanco 28049, Madrid Spain

Contract:
The selected Ph.D. candidate will be employed for a period of 3 years (+1 additional year depending of funding and status of the Project). The net gross salary per year will be €26733,28. The preferring starting date is May–June 2015, although it may be adapted to the selected candidate.

Application:
If you are interested, please send a Curriculum Vitæ (indicate your mean grade of the Degree, details on the Master studies, and any research experience you may have), and a short letter of motivation before 11$^{\text{th}}$ April 2015 to the following e-mail address:
marcelino.agundez@icmm.csic.es

For further details you can contact:
Prof. José Cernicharo Quintanilla
jose.cernicharo@csic.es

Dr. Marcelino Agúndez Chico
marcelino.agundez@icmm.csic.es

Full Professor
Monash Centre for Astrophysics, Monash University, Australia

The School of Physics and Astronomy is a new School located within the Faculty of Science. It was formed as a result of merging the School of Physics with astrophysicists from the School of Mathematical Sciences. The School aims to position itself as one of the top physics and astronomy research and teaching departments in Australia. In the past four years the School has gone through an exciting period of renewal – investing significantly in people and facilities. The School of Physics and Astronomy is committed to teaching and research of the highest quality in astronomy, astrophysics, experimental physics, and theoretical physics; it aims to produce graduates with a solid foundation in physics and astrophysics. We are recognised internationally for research in several fields of physics and astrophysics; however, we are focused on significantly strengthening our research base to achieve the status of a top ranked international department.

Currently the School has 26 academic staff, 28 research-only staff and 17 adjunct staff, supported by 10 professional staff. In 2014 the School's total recurrent income was approximately $15M, with research income in the past four years totaling over $22M.

The School conducts research in areas ranging from astrophysics, atomic physics and particle physics to biophotonics, condensed matter physics, and synchrotron science. It is actively involved in four research centres:

- The Monash Centre for Astrophysics (MoCA – http://moca.monash.edu);
- The ARC Centre of Excellence for Particle Physics at the Terascale (CoEPP) http://www.coepp.org.au/);
- The Monash Centre for Electron Microscopy (MCEM – http://mcem.monash.edu.au);
- The Monash Centre for Atomically Thin Materials (http://fuhrerlab.physics.monash.edu/).

In addition, the School has over a dozen Australian Research Council funded programmes and is an active user of the Australian Synchrotron and the Melbourne Centre for Nanofabrication, which are located adjacent to the Clayton Campus of Monash University.

Modern laboratory facilities are a high priority in the School's Strategic Plan. In 2013 the School's research laboratories relocated to a new building – the $175M New Horizons Centre (NHC).

Astronomy and Astrophysics
The School hosts the Monash Centre for Astrophysics, which is one of the most diverse astrophysics research groups in Australia. Major areas of research include: active galaxies, astrophysical fluid dynamics and magnetohydrodynamics, galaxy evolution, first stars, the formation of stars, stellar evolution, stellar nucleosynthesis, nuclear astrophysics, chemical evolution, galactic archæology, supernovæ, supernova remnants, neutron stars, stellar transients, supermassive black holes, high energy astrophysics, gravitational wave astronomy, stellar and planetary dynamics, and exoplanets. The Australian astrophysics community is heavily involved in major observational and computational facilities, including the Australian Square Kilometre Array Pathfinder (ASKAP), the Giant Magellan Telescope, the Australian Astronomical Observatory, Skymapper, HERMES, NCI, and the Green II and gSTAR supercomputers. In addition the School conducts research into particle physics and cosmology through the ARC Centre of Excellence for Particle Physics at the Terascale (CoEPP). It is also member of the Joint Institute for Nuclear Astrophysics and has close collaborations with the Center for Nuclear Astrophysics at Shanghai Jiao Tong University.

Applicants will be considered in any of the School's current research areas in astronomy and astrophysics; however, exceptional applicants in other areas of astronomy and astrophysics are also encouraged to apply.

See also http://jobs.monash.edu.au/jobDetails.asp?sJobIDs=531173&lWorkTypeID=&lLocationID=&lCategoryID=641%2C+640%2C+636&lBrandID=&stp=AW&sLanguage=en

STFC Introductory Summer School: Atomic processes and spectral modelling in astrophysics

STFC Introductory Summer School
Atomic processes and spectral modelling in astrophysics
31st August 2015 – 4th September 2015
Astrophysics Research Centre, School of Mathematics and Physics, Queen's University Belfast

Spectroscopy makes an essential contribution to the study of a myriad of astronomical sources, ranging from the Sun to the most distant quasars. Modelling of the emission and/or absorption line spectra of such sources provides a wealth of information on their fundamental properties, including (but not limited to) velocity, temperature, particle density and chemical composition. Vital requirements for the reliable modelling of astronomical spectra include: (i) knowledge of the atomic processes which are important in generating the spectrum, (ii) accurate atomic data for these processes, either measured in the laboratory or calculated using atomic structure packages, (iii) sophisticated spectral modelling codes, which include all relevant atomic processes and produce a realistic spectral model which may be confidently compared with observations.

The STFC Introductory Summer School is designed to play an essential role in the early training of both Ph.D. students and postdoctoral researchers in all of the above by providing:

- an introduction to the atomic processes of importance in different types of astronomical sources;
- how data for these processes are measured or (more often) calculated;
- an introduction to the various computer codes available for modelling astronomical spectra;
- what information spectral modelling codes can provide on astronomical sources, ranging from the Sun to quasars, and what are their limitations;
- an introduction to current and future spectroscopic facilities available to UK astrophysicists;
- advice on career development and public engagement;
- allowing Ph.D. students and postdoctoral participants to interact scientifically with each other, and also with lecturers who are leaders in their research field.

The Summer School, including accommodation, meals and travel expenses, is free for STFC-sponsored and self-supporting Ph.D. students, and tuition-free for many other categories of students and postdoctoral researchers. More information and a draft lecture schedule can be found on the Summer School website:

http://go.qub.ac.uk/stfc-iss

Registration for the Summer School is now open via the above website, and should be completed by Friday 3rd July 2015 to guarantee accommodation.

Please contact the Summer School director Francis Keenan at f.keenan@qub.ac.uk if you have any questions.

See also http://go.qub.ac.uk/stfc-iss

SECOND ANNOUNCEMENT:
Exoplanetary Atmospheres and Habitability Thermodynamics, Disequilibrium and Evolution focus group
Nice, from 12 to 16 October 2015

Dear colleagues,

We are glad to annonce the "Exoplanetary Atmospheres and Habitability –Thermodynamics, Disequilibrium and Evolution focus group" workshop that will be held in Nice at the Observatoire de la Côte d'Azur from 12 to 16 October 2015.

http://exoatmo.sciencesconf.org

The first indicative program is available here:
http://exoatmo.sciencesconf.org/program
The registration is free and includes lunches during the week as well as the social event
http://exoatmo.sciencesconf.org/registration/index
We encourage Ph.D.s and Postdocs to apply and to submit an abstract:
http://exoatmo.sciencesconf.org/submission/submit
There is a small amount of money for financial support to young researchers, please apply here before April 30th 2015:
http://exoatmo.sciencesconf.org/resource/page/id/4

IMPORTANT DATES

- April 30th, 2015: Deadline for financial support request
- June 30th, 2015: Deadline for registration and abstract submission
- October 12th, 2015: The workshop starts

Looking forward to seeing you in Nice this year,
Eugenio Simoncini and Andrea Chiavassa on behalf of the SOC

SCIENTIFIC RATIONALE
The aim of the workshop is to discuss chemical disequilibrium and its link to planetary habitability. In particular, the Thermodynamics, Disequilibrium and Evolution focus group seeks to understand how disequilibria are generated in geological / chemical / biological systems, and how these disequilibria can lead to emergent phenomena, such as self-organization and eventually, metabolism. The prospects for planetary atmosphere characterization are excellent with access to a large amount of data for different kinds of stars either with ground- or space-based telescopes, and supported by accurate modeling of atmospheric compositions and their corresponding spectra. In particular, for many discovered exoplanets (hot and gaseous), a large chemical disequilibrium in the atmosphere has been observed, due to the high vertical temperature gradient. Several new studies are now comparing this vertical-mixing driven disequilibrium with the chemical disequilibrium characterizing the atmosphere of planet Earth, which is mainly due to the presence of life. However, present research on exoplanet's atmospheric disequilibrium is focused on a very small number of compounds (CH_4, CO, CO_2, H_2O), and lacks a generalized and wider methodology. In this workshop we plan to enlarge these studies to a joint effort between the thermodynamics of habitable conditions and exoplanetary atmospheres.

Three principal topics will be tackled during the workshop:

- Icy moons, icy planets and the conditions for the emergence of life
- The modeling and observations of exoplanetary atmospheres: chemistry and physics
- The chemical disequilibrium in planetary atmospheres: from hot Jupiters to habitable planets

INVITED SPEAKERS

- Icy moons, icy planets and the conditions for the emergence of life
  Laurie Barge – JPL, CalTech, Pasadena (USA)
  Athena Coustenis – Observatoire de Meudon, Meudon (France)
  Robert Pascal – CNRS and Université de Montpellier (France)
- The modeling and observations of exoplanetary atmospheres: chemistry and physics
  Daniel Angerhausen – Goddard Space Flight Center, NASA, Greenbelt (USA)
  Renyu Hu – Jet Propulsion Laboratory (USA)
  Franck Selsis – Observatoire de Bordeaux, Bordeaux (France)
- The chemical disequilibrium in planetary atmospheres: from hot Jupiters to habitable planets
  Sebastian Danielache – Sophia University, Tokyo (Japan)
  Tommaso Grassi – Starplan, University of Copenhagen, (Denemark)
  Eugenio Simoncini – Astrophysical Observatory of Arcetri, INAF, Firenze (Italy)

See also http://exoatmo.sciencesconf.org

Second announcement of Summer Schoool:
New Era of the Cosmic Distance Scale

We are pleased to announce that registration is now open for Summer School on the Cosmic Distance Scale which will be held in the University of Tokyo, Japan, from Mon 29 June to Fri 3 July 2015. This school will cover a wide range of distance measurement techniques from trigonometric parallaxes to cosmological distance measurements and related scientific topics. Distinguished lecturers in various fields will give dedicated lectures on the basics and cutting edge of the field of distance measurement as well as on expected future developments. Please find more details and the registration form on our web site: http://stella.astron.s.u-tokyo.ac.jp/CDSchool/

Invited Lecturers

Nabila Aghanim	Cosmic Microwave Background (CMB)
Giuseppe Bono	Theoretical breakthroughs for radial variables
Richard de Grijs	Introduction/Summary and outlook to the future
Gerard Gilmore	Gaia: applications to the distance scale
Shrinivas Kulkarni	Supernovæ
Barry Madore	Population II distance indicators
Francois Mignard	Gaia: principles and techniques
Takeo Minezaki	Active Galactic Nuclei (AGNs)
Grzegorz Pietrzynski	Eclipsing binaries
Mark Reid	VLBI parallaxes
Sherry Suyu	Gravitational lensing
Masahiro Takada	Baryon Acoustic Oscillations (BAOs)
Patricia Whitelock	Asymptotic Giant Branch variables
Daisuke Yonetoku	Gamma-Ray Bursts (GRBs)

SOC:
Giuseppe Bono, Richard de Grijs, Mamoru Doi (Co-chair), Naoteru Gouda, Mareki Honma, Noriyuki Matsunaga (Co-chair), Takeo Minezaki, Ken'ichi Nomoto, Hiromoto Shibahashi, Naotaka Suzuki, Tomonori Totani, Yuzuru Yoshii

LOC:
Laura Inno, Noriyuki Matsunaga (Chair), Takeo Minezaki, Tomoki Morokuma, Nobuyuki Sakai, Takuji Tsujimoto

Contact:
cdschool_loc@astron.s.u-tokyo.ac.jp

See also http://stella.astron.s.u-tokyo.ac.jp/CDSchool/